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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/758,740	01/16/2004	Wade Thomas Cathey JR.	414671	6369

30955 7590 03/20/2006

LATHROP & GAGE LC  
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BOULDER, CO 80301

EXAMINER
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CHANG, AUDREY Y

ART UNIT	PAPER NUMBER
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2872

DATE MAILED: 03/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/758,740

Applicant(s)

CATHEY ET AL.

Examiner

Audrey Y. Chang

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 06 January 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 7,8 and 11-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 7,8 and 11-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |                                                                                                                        |                                                                                         |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                            | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____                                                |

## DETAILED ACTION

### *Remark*

- This Office Action is in response to applicant's amendment filed on January 6, 2006, which has been entered into the file.
- By this amendment, the applicant has amended claims 7-8 and 11 and has newly added claims 12-23.
- Claims 7-8, and 11-23 remain pending in this application.

### *Claim Objections*

1. **Claims 7-8 and 11-23 are objected to because of the following informalities:**

(1). The **amended** claims and the *newly added claims* recite a phrase "an ambiguity function ... is a function of normalized spatial frequency parameter  $u$  and a vertical variable  $v$  related to misfocus parameter  $\psi$ " that is confusing and indefinite since firstly it is really not clear what exactly is the physical meaning of this ambiguity function and it is really not clear what is the physical meaning of this *vertical variable*" to make the ambiguity function not being ambiguous and has definite physical meaning. The amended claims and the newly added claims further recite the phrase "such that a main lobe of the ambiguity function is broader in  $v$  for a given value of  $u$ " that is really confusing since both the ambiguity function and the variable  $v$  are not defined in the physical terms it is not clear what exactly is the physical meaning of this phrase. Also what does it mean that the "main lobe" is broader? What is being measured by this "lobe" or "main lobe" to make the phrase with definite physical meaning? What is considered to be "vertical variable"? Vertical respect to what?

(2). The amended claims and the newly added claims recite the phrase "the PSF has a functionally different form" is confusing and indefinite since it is not clear what does it mean by

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“functionally different form”? Does it mean different mathematical function form? Or does it mean it has different optical or physical functions?

**For the above reasons the scopes of the claims are not well definite.** Appropriate correction is required.

### ***Information Disclosure Statement***

2. The information disclosure statement filed on January 16, 2004 contains a list of more than 150 references. Applicant has submitted a list of “relevance” with regard to each of the references, where some of the references have been indicated such as “microscope”, “zoon lens” or “variable lens” etc. yet it is not clear how do they either relevant or not relevant to this application?

In response to applicant’s arguments concerning the requirements of MPEP, the applicant is respectfully requested to document their “doubts” explicitly concerning each reference of the list whether being “material” to the merits of the invention or not so that the examiner can consider them properly.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. **Claim 7, 11 and newly added claims 12-14, 16, 18, 20, and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by the patent issued to Kubo et al (PN. 4,480,896).**

**Kubo et al** teaches an *imaging optical system* such as a photographic system having a sharp *objective lens* and an *optical mask* (Figure 1) having different **phase** modulation portions (11 and 12) for

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forming an optical image. Kubo teaches that the optical mask creates phase difference to the wavefront which therefore *modulates the phase* of the wavefront so that the *modulated* optical transfer function, which is the optical transfer function for the imaging optical system, does not have value zero over a range of spatial frequency, (please see Figure 2). It is implicitly true that the imaging optical system such as the photographic system has a detector, such as a film or a CCD detector, for detecting the optical image. Kubo et al further teaches that the optical mask also modulating the wavefront of the light from the sharp objective lens to make the imaging system has a *soft focus effect* which implicitly means that it creates *an extend of the depth of focus* that is larger than the focus of the imaging system without the optical mask, (please see column 1-2).

**The amended claims 7 and 11 and the newly submitted claims 12, 14, 16, and 18-20** have added the following features: the imaging system is characterized by at least by an ambiguity function and a point spread function which ambiguity function is a function of a normalized spatial frequency parameter and a vertical parameter related to a misfocus parameter and which point spread function is at least a function of the misfocus parameter. **Kubo et al** in Figures 2 and 4 show explicitly the *modulation transfer function* as a function of *spatial frequency* for the imaging system. One skilled in the art knows that the *modulation transfer function* is really the two dimensional Fourier transformation of the point spread function of the imaging system and is the real magnitude of the *optical* transfer function of the imaging system. This means the imaging system is characterized by a *point spread function*. The Fourier transformation is a transformation between the spatial coordinate and the spatial frequency coordinate which means the point spread function is a function of spatial coordinate which with simple mathematical calculation it can be written as a function of *misfocus parameter*, (i.e. in the spatial coordinate). As for ambiguity function, the claims fail to define what exactly is this ambiguity function, which makes this feature can only be examined in the broadest interpretation. The optical transfer function, which is a

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function of the spatial frequency can be identified as the ambiguity function, which makes the imaging system is characterized by an ambiguity function.

With regard to the features “a main lobe of the ambiguity function is *broader* in  $v$  for a given value of  $u$  ... in comparison to the main lobe of an ambiguity function ... characterized the imaging system without the optical mask for those given values of  $u$  and  $\psi$  over an extended depth of focus larger than a depth of focus formed without the optical mask”, recited in **amended claims 7 and 11 and newly added claims 12, 14, 16, and 18-20**, since the ambiguity function, the parameter  $v$  and the “main lobe” are not well defined, these features can only be examined in the broadest interpretation. Kubo et al does teach that the optical phase mask is capable of creating soft focus or extending the depth of the focus, it is believed that it is implicitly true that the optical mask will have this inherent function of increasing the main lobe if the optical phase mask extends the depth of the focus.

With regard to the feature concerning point spread function has a functionally different form, as recited in amended claims 7 and 11 and newly added claims 12, 14, 16 and 18-20, it is implicitly true that the point spread function for an optical imaging system with an optical phase mask and without an optical phase mask will be at least mathematically different since the point spread function for the system with the optical phase masks to include the effect of this phase mask.

With regard to claims 11-12, the misfocus parameter stated in the claim is well known standard parameter in the art for measuring the misfocus of an imaging system. The range of the misfocus recited in claim 12 seems to be arbitrarily selected.

With regard to claims 13, 16, 20 and 23, Kubo et al teaches that the optical phase mask is provided with an imaging system such as photographic system, which implicitly includes a lens. Although this reference does not teach explicitly that the optical mask and the lens are integrally formed such modification would have been obvious to one skilled in the art for the benefit of reducing the number of the elements in the photographic system for the benefit of providing compact design.

**5. Claim 8 and newly added claims 15, 17 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over the patent issued to Kubo et al and in view of the article “Optical/digital incoherent image processing for extended depth of field” by Poon et al (Applied Optics Vol. 26, No. 21, page 4612).**

The optical mask taught by **Kubo et al** that modulates phase of the wavefront and creates soft focus effect for an optical imaging system including a sharp focus objective lens as described for claim 7 above has met all the limitations of the claims. It is implicitly true that an imaging system has a detector for detecting the optical image however this reference does not teach explicitly to include a post-processor for processing the detected optical image to reverse the blurring effect.

**Poon et al** in the same field of endeavor teaches an *optical /digital image processing apparatus* and *method* for generating an optical image wherein the apparatus comprises an *optical lens* and an *optical mask* for forming the optical image and modulating a wavefront such that *an extended field of depth* is resulted and *zeros* of the *optical transfer function*, describing the optical functions of *both* the mask and the lens, are eliminated, (please see Figure 1-3, and the entire document). **Poon et al** further teaches to include *digital image* processing arrangement, serves as the post-processor, (please see Figure 5), including a *computer generated filter* to *reverse* or *compensating* the effects of the mask so that the lost image contrast in the detected image can be restored. The digital image processing arrangement certainly includes an image detector to transform the optical image into electronic image and digital image processor for processing the electronic image. The final electronic image from the optical/digital image process apparatus is clearer over the extended depth of focus as compared to the electronic image obtained without using the mask. It would then have been obvious to one skilled in the art to apply the teachings of **Poon et al** to apply this post-processing scheme to the detected image and to add this digital

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image process arrangement to the imaging system of Kubo et al for the benefit of allowing the blurring effect introduced by the optical mask be reversed or eliminated so that a clearer image can be obtained in the photographic imaging system.

### ***Double Patenting***

6. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

7. **Claims 7-8, 11 and 12-23 are provisionally rejected** under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 75-79, 82-84, 87, 89-101, 103-105 and 107 of copending **Application No. 09/070,969**. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system to extend depth of the focus of the imaging system with same functional characteristics for the inherent point spread function and the ambiguity function characterized the imaging system.



This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

8. **Claims 7-8, 11 and 12-23 are provisionally rejected** under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 1 of copending **Application No. 11/192,572**. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system to extend depth of the focus of the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

9. **Claims 7-8, 11, and 12-23 are rejected** on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-21 of **U.S. Patent No. 5,748,371**. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system and to extend depth of focus for the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system. Furthermore, both the instant application and the cited patent claim the same cubic phase modulation for the optical mask.

10. **Claims 7-8 and 11-23 are rejected** on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-6, 9-18, and 21-22 of **U.S. Patent No. 6,525,302**. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system and to extend depth of

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focus for the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system.

11. **Claims 7-8 and 11-23 are rejected** on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-4 of U.S. Patent No. 6,873,733. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system and to extend depth of focus for the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system.

12. **Claims 7-8 and 11-23 are rejected** on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-29 of U.S. Patent No 6,911,638. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system and to extend depth of focus for the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system. Furthermore, both the instant application and the cited reference disclose the phase modulation includes cubic phase modulation.

13. **Claims 7-8 and 11-23 are rejected** on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No 6,940, 649. Although the conflicting claims are not identical, they are not patentably distinct from each other because both sets of claims recite an optical mask for altering phase of an imaging system and to extend depth of focus for the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system.

14. **Claims 7-8 and 11-23 are rejected** on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-5 of U.S. Patent No (not yet assigned Application number 10/355,761. Although the conflicting claims are not identical, they are not patentably distinct

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from each other because both sets of claims recite an optical mask for altering phase of an imaging system and to extend depth of focus for the imaging system. Although the cited reference does not teach explicitly about the ambiguity function and the point spread function, such functions are inherent for the imaging system. Furthermore, both the instant application and the cited reference disclose the phase modulation includes cubic phase modulation.

### *Response to Arguments*

15. Applicant's arguments with respect to amended claims 7-8, 11 and newly added claims 12-23 have been considered but are moot in view of the new ground(s) of rejection.

16. Applicant's arguments with regard to newly added features have been fully considered and are rejected and addressed in paragraphs above.

17. In response to applicant's arguments, which state that the cited Kubo reference is disclosed to obtain focused image, which therefore cannot be combined with cited Poon reference, the examiner respectfully disagrees for the reasons stated below. Firstly, Kubo reference teaches explicitly to use the phase mask to create **soft focus**, namely to extend the depth of focus, just the same as the instant application for reducing the sharpness of the objective lens, (please see column 1). Poon reference teaches an image processing means for processing the image obtained by masking to remove the unwanted effect of the mask to make the final image more desirable. The combination of the two references therefore is reasonable for the motivation of processing the image obtained by the photographic system with the phase mask to obtain more desired image by digitally removed the unwanted effect of the mask.

*Conclusion*

18. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Audrey Y. Chang whose telephone number is 571-272-2309. The examiner can normally be reached on Monday-Friday (8:00-4:30), alternative Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on 571-272-2312. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

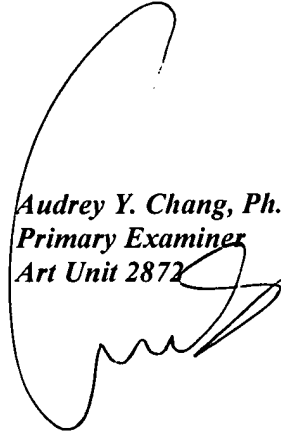
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A. Chang, Ph.D.

*Audrey Y. Chang, Ph.D.*  
*Primary Examiner*  
*Art Unit 2872*

A large, stylized handwritten signature in black ink, which appears to be 'Audrey Y. Chang', is written over the typed name and title.